

Instructions

for Operating the

Burroughs Calculator



Burroughs Adding Machine Company
DETROIT, MICHIGAN

ADDING • CALCULATING • BILLING AND ACCOUNTING MACHINES
TYPEWRITERS • CASH REGISTERS • CORRECT-POSTURE CHAIRS

Ex Libris



D. E. OTTO

¶ The purpose of this manual is to provide simple instructions in the operation of the machine, covering its common uses in business.

¶ The correct operation of the Calculator and its application to commercial calculations depends first on a knowledge of commercial arithmetic, and second on a fundamental knowledge of machine calculation.

¶ When the operator is familiar with the arithmetic of the problem to be solved, the application of the machine becomes extremely simple.

¶ This book is not intended for school use as it does not contain sufficient problems for practice.

¶ An instruction book containing practice problems, written for use in schools and colleges, and also special problems for practice in adding, may be obtained at nominal prices from any Burroughs office or by writing to

Burroughs Adding Machine Company
Detroit, Michigan

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THE BURROUGHS CALCULATOR

The Burroughs Calculator performs additions, multiplications, subtractions and divisions . . . easily . . . quickly. It is a non-listing, direct key-actuated type of machine—results appear in the dials instantly upon the depression of amount keys.



The Burroughs Electric Calculator With Single Accumulator



The Burroughs Electric Duplex Calculator

SIMPLE TO OPERATE

The operation of a Burroughs Calculator is extremely simple. There is no crank to turn, no lever to pull, no motor bars to operate in order to record amounts. To clear the machine, only one operation is required—depress a motor bar or key if an electric machine; pull a lever if a hand machine.

KEYBOARD

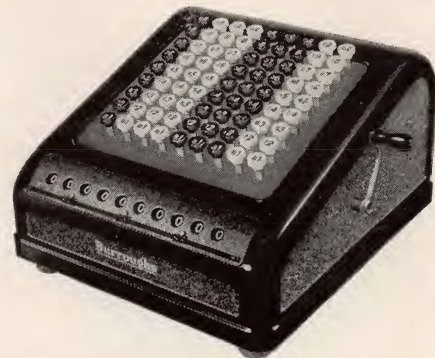
The keyboard is simple—similar to a listing machine. It has color divisions for dollars and cents. Thus figures are added the same way they are written in columns on ruled paper. The first two columns at the right are for units and tens of cents; the next three columns are for units, tens and hundreds of dollars, etc.

On each keytop there is a large and a small figure. The large figures are used for additions and multiplications—to *increase* amounts. The small figures are used for subtractions and divisions—to *decrease* amounts.

The odd numbered keys are concave and the even numbered keys are flat. This facilitates the location of the keys by sense of touch.

MANY STYLES AND SIZES

Burroughs Calculators are available in a choice of sizes, either manually or electrically operated. Electric Calculators are furnished with single accumulators or with two accumulators. The Electric Duplex machine (two accumulators) is equipped with a key for direct subtraction from the rear accumulator.



The Burroughs Manually Operated Calculator

BURROUGHS LEADS IN CALCULATING MACHINE DEVELOPMENT

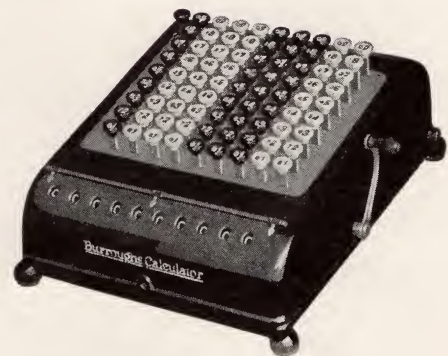
THE EARLIEST BURROUGHS

The first model of Burroughs Calculator, known as the Burroughs non-lister, Style 520, was first offered for sale in 1911. This machine was commonly known as the "box type" on account of its shape. Box type machines have not been manufactured by the Burroughs Company for nearly thirty years, but there are a number of them still in use, giving satisfactory service.



THE FIRST BIG IMPROVEMENT

In 1914, Burroughs redesigned the Calculator and eliminated the long-lever type construction. In this new model, Burroughs was first to introduce the principle of gear-controlled mechanism which adds and carries simultaneously—a mechanical principle not obtainable in the old style lever-controlled machines. By further improvements in construction, the new Calculator was made smaller and lighter than the old "box type" machine because approximately 50 per cent of the total number of parts was eliminated.



STYLE 5 05 05

The Style 5 05 05, a machine with 5 columns of keys and 6 columns totaling capacity, was released for sale in the early part of 1928. It was the first time that a low-priced key-driven Calculator was offered to handle the many calculating jobs involving small amounts. Today this machine is still the lowest priced key-actuated Calculator on the market.



Style 5 05 05

THE FIRST ELECTRIC

In 1928, Burroughs introduced the first *electric* key-actuated calculating machine. All calculations were thereby made easier and with greater speed than ever before possible on any machine not motor driven.

Proved Production

Many users state that the Burroughs electric key-board increases production from 10 per cent to 15 per cent over hand-operated key-driven Calculators. This is due to the short, uniform, easy, positive key action.



Accuracy of Registration

Accuracy of registration is assured by the motor-driven computing mechanism. The depression of a key causes the motor to register the full value of the key on the dials. Partial registration is impossible.

Electric Key Touch—Light and Uniform

The key touch is light and is exactly the same for all keys. The key depression merely actuates the motor. The motor furnishes the power to operate the computing mechanism.

The short key depression and light touch make possible a greater span of the keyboard. For example, \$10.90 may be easily held with the thumb and middle finger of the right hand when multiplying.

Increased rhythm and ease of operation—made possible by the light, uniform key action—result in reduction in operator fatigue and increase in speed of calculating.

Intermittent Motor

The motor starts automatically when a key is depressed—and stops automatically when the key restores. It does not run when the machine is not being operated, thereby eliminating the nervous strain of having to listen—constantly—to the sound of a running motor.

THE FIRST DUPLEX

Burroughs was first to offer an all electric Duplex Calculator (in 1933). This machine has two accumulating registers which make it possible to obtain answers of separate calculations—then, without any extra effort, to obtain the grand total. The result of each calculation appears in the front dials. When the front dials are cleared, the result automatically transfers to the rear accumulator. If desired, the front accumulator may be cleared without transferring the result or both accumulators may be cleared simultaneously. Also, if desired, fractions may be prevented from transferring to the rear accumulator, thus only full-cent amounts are accumulated. This assures that the total will exactly balance with the full-cent results of individual calculations.



SIMPLIFIED SUBTRACTION

In 1936 the Burroughs line of single dial electric Calculators was further modernized by the addition of simplified subtraction—an exclusive Burroughs feature—which had been previously introduced on the duplex. At the same time, the machine was also equipped with improved keytops and quicker clearance. Other improvements and refinements were embodied to provide faster and quieter key action and a more attractive appearance. This machine is today one of the most popular of Burroughs Calculators.



FIRST WITH DIRECT SUBTRACTION



Still leading in the development of key-actuated calculators, Burroughs released for sale the Electric Duplex Calculator with direct subtraction in 1937. This made subtraction—for the first time—just as easy as addition, on a key-actuated calculator. By operating the subtract key, an amount in the front dials is directly subtracted from the rear dials. This feature filled a long-felt need for a simpler and faster method of handling deductions from an accumulated amount.

EXTENSIVE USE OF CALCULATOR EQUIPMENT

The value of the calculating machines being used by some of the larger business enterprises exceeds the combined value of all other classes of figuring machines. As examples, a large automobile manufacturer uses over 1,500 key-actuated calculating machines; two railroads and two mail order concerns each use over 1,000. These are only a few of many examples.

Every manufacturing concern or wholesaler has calculations in connection with the following:

1. Calculation of wages for payroll purposes.
2. Analysis of wages for costing purposes.
3. Calculation of purchase invoices.
4. Calculation of sales invoices.
5. Other general calculating work.

Banks have a large volume of work for calculating machines in figuring service charges and interest.

ADDITION

Addition is accomplished by merely depressing the keys (large figures) which represent the amounts to be added. The results appear instantly in the dials—there is no handle to pull, crank to turn or motor bar to depress.

Since the answer appears when the keys are operated, care must be taken to operate the right keys, as errors can only be detected by re-adding the amounts. Illegible figures are the chief cause of errors; therefore, particular care should be exercised in reading figures.

There are two methods of addition—the full keyboard method and the touch method.

FULL KEYBOARD METHOD

This is similar to the Short-Cut Method used on Burroughs adding-listing machines. Keys 1 to 9 are used and two or more keys, often the entire amount, are depressed simultaneously. This is the preferred method when a small amount of adding is to be done by an operator who is not trained in the touch method.

TOUCH METHOD

The touch method is recommended where there is a large volume of adding. It permits greater speed with the minimum of fatigue because a rapid rhythmic operation is possible and it is not necessary to look at the keyboard.

Only keys 1 to 5 are used. For 6, the 3 key is operated twice. The 4 and 3 keys are operated for 7; 4 twice for 8; 5 and 4 for 9. Seven of the nine figures are added by use of only three keys (3, 4 and 5).



CORRECT POSITION OF MACHINE

The Calculator should be placed on the desk in front, and slightly to the right, of the operator and turned at an angle so the forearm will be parallel with a line from the 1¢ to the \$9.00 key. This is the most convenient position for machine operation and for reading the dials. The keyboard of the machine should be low enough to permit operation with the minimum of arm fatigue. In many cases, an especially designed calculating machine desk or stand having a well for the machine is used.

HOLDING A PENCIL

A pencil should be held between the thumb and the palm of the hand while adding. This saves time in writing answers and has a stabilizing effect on the muscles, thereby giving the operator greater confidence.

USE THE FIRST AND SECOND FINGERS FOR ADDING

The second finger is used for adding only in the extreme right-hand column. The first finger is used for all other columns. An exception to this is sometimes made when adding columns of large amounts. Such amounts may be split into two parts and only the cents added first with the two fingers, then the dollars added, or vice versa.

For uniformity of operation, the keys are always depressed in the order in which the amounts are read.

WORK DOWN THE KEYBOARD FOR 7 AND 9

In operating keys 4 and 3 for 7, and 5 and 4 for 9, it makes no difference in the accuracy of the work on the Calculator whether the lower or the higher key is depressed first. However, a uniform method is important to insure accurate, fast operation. It is recommended that the higher key be depressed first.

RHYTHMIC ACTION

In addition, the movements of the hand and forearm should be timed to insure smooth, regular action—not too fast nor too slow.

Rhythmic action is just as essential in learning to operate the Calculator as it is in learning to perform on a musical instrument. Only by a steady, rhythmic motion of the hand and forearm can the maximum speed and accuracy be attained. Any tendency to vary the time between key strokes when there is a difference in the span between the keys, or to “gallop” through particularly easy combinations should be carefully avoided, as such uneven operations usually result in fumbling.

The sense of key location—the next most important objective in learning the operation of the machine—will come naturally from practice. All adding work is performed on only five rows of keys and more than one-half of it on the 3 and 4 keys. Thus, it will be seen that skill in key location can be easily acquired with a little practice.

A FINGERING EXERCISE

Place the first and second fingers of the right hand on the 44¢ keys and strike each key five times alternately, continuing the operation until you are able to change from one finger to the other without interrupting the rhythm. Then repeat the exercise, striking each key four times, then three times, then twice and finally only once.

In striking the keys, the fingers should be raised slightly above the keyboard. The motion should come from the forearm and a flexing of the wrist, and not from the finger muscles.

The problems on the opposite page are given as examples only. “Addition Drills,” Form C 2054, and “Addition Practice Problems,” Form C 2050, are available for more complete practice. For the first ten problems on the opposite page only the 3 and 4 keys are used. In the next ten problems keys 3, 4 and 5 are used in adding seven of the nine digits. Keys 1 to 5 are used for adding the remaining problems.

Form the habit of always clearing the machine before beginning a new problem.

EXAMPLE PROBLEMS

1	2	3	4	5	6	7	8	9	10
40	3	44	63	38	37	38	84	66	37
40	3	48	36	46	63	36	37	74	34
40	3	88	33	68	44	74	68	83	46
40	3	44	63	44	48	76	73	37	44
4	30	84	33	48	67	38	74	84	83
4	30	44	63	86	34	37	86	76	67
4	30	48	63	33	74	64	33	38	77
4	30	44	66	34	87	73	47	34	38
40	3	84	33	44	64	84	84	44	63
40	3	44	36	83	33	67	86	83	38
40	3	48	36	66	74	66	38	66	48
40	3	88	33	34	83	38	43	76	87
11	12	13	14	15	16	17	18	19	20
45	49	36	74	47	26	39	67	73	45
55	54	74	63	45	94	83	72	87	34
54	59	85	83	74	35	62	45	32	73
44	44	44	47	67	47	73	69	65	42
45	94	58	77	66	56	46	49	33	43
55	59	37	64	48	37	97	23	78	94
45	99	78	49	34	79	64	48	87	73
54	45	33	46	49	82	32	66	95	62
45	54	44	33	48	43	33	98	88	46
44	55	68	37	88	98	84	28	73	94
55	59	54	89	76	88	37	76	64	88
54	44	85	44	63	27	44	36	36	27
21	22	23	24	25	26	27	28	29	30
45	73	29	37	46	74	68	82	64	86
34	53	75	43	63	83	82	32	52	76
73	42	93	81	64	28	36	87	96	14
42	37	24	33	91	26	36	48	74	52
43	54	52	65	72	49	38	73	19	14
94	64	33	72	86	44	35	68	88	68
73	56	66	79	49	91	24	88	74	29
62	46	37	17	14	75	74	91	15	87
46	45	47	56	93	26	87	26	98	51
94	32	75	91	94	54	68	83	67	26
88	83	54	37	25	31	21	45	18	75
27	87	81	74	64	65	37	27	19	51

ADDING SALES CHECKS OR SIMILAR MEDIA

Adding of sales checks differs from adding columns of figures, only in that a slip must be handled for each amount. The operation of turning the checks is performed with the left hand and requires practice to become skillful. It is not practicable when the accounts are on separate sheets to split large amounts as suggested on the previous page.

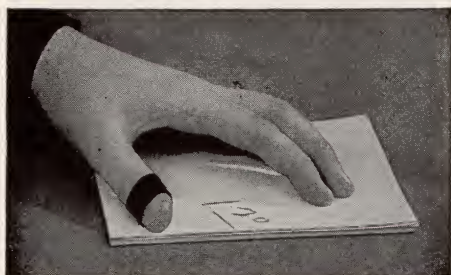


Fig. 1



Fig. 2



Fig. 3

Turning Sales Checks

The proper way to turn sales checks is to place a bundle of checks at the left of the Calculator, holding them with the fingers of the left hand as shown in Figure 1.

The fingers hold the checks, and the thumb raises them. This is accomplished by pressing the thumb against the check near the corner, and drawing it toward the palm of the hand. See Figure 2.

As the check buckles, it is caught by the first finger, and held while the amount on the next check is read as shown in Figure 3.

A rubber band used on the thumb as shown in the accompanying illustrations is essential to the rapid handling of the checks.

Sub-total

After a number of checks have been added, they should be placed face down in a separate pile. The sub-total may be written on the back of the last check in the pile. This enables the operator to

prove more readily as errors can be localized to batches. Sub-totals may also be noted after every twenty-five to fifty items when adding long columns of figures.

FUMBLING

Fumbling—the unintentional partial depression of keys—is usually the result of faulty rhythm or of a beginner attempting great speed before key location and the combination of strokes for figures above 5 have become fully subconscious habits.

In adding on the Burroughs Calculator, it will be noticed that the key action assists the beginner and offers greater facility for rapid and accurate operation. The key stroke of the hand-operated machine becomes lighter after the initial force to start the key. With the electric, a partial registration of a key value is impossible; and the length of the key depression necessary to record a key value is designed to provide a very light touch, yet not so light as to cause the adding mechanism to be affected by an accidental brushing of a key.

MULTIPLICATION

Multiplication represents over 40 per cent of the calculating work in the average office. It is the chief factor in commercial calculations. Although multiplication is easy and simple with a Calculator, it is exceedingly tedious to multiply mentally hour after hour, using pencil-and-paper methods.

Machine Figuring

To appreciate the great difference between manual and machine methods of figuring, perform several calculations with pencil and paper and then solve the same problems with the Calculator. The ease and speed with which correct results may be obtained should convince the most skeptical of the superiority of the machine method. It is very easy to obtain the product of two factors on the Calculator *in less time than it takes to write them on paper preparatory to the manual multiplying operation.*

SIMPLE MULTIPLICATION (Right to Left)

Machine multiplication is repeated addition. The large figures on the keytops are used and all keys for the amount to be multiplied are depressed at the same time. To multiply 278×3 , 278 is merely added three times.

$$\begin{array}{r} 278 \\ 278 \\ 278 \\ \hline 834 \end{array} \qquad 278 \times 3 = 834$$

To multiply 278×30 , instead of adding 278 thirty times, it is merely moved one column to the left (which multiplies it by ten) and is added three times.

$$\begin{array}{r} 2780 \\ 2780 \\ 2780 \\ \hline 8340 \end{array} \qquad 278 \times 30 = 8340$$

The multiplication of 278×33 is merely the combination of the above two steps.

The similarity of the above to the lead-pencil method is apparent. In the lead-pencil method, after multiplying by the right-hand figure, the amount is multiplied by the next figure to the left and the answer set down one place to the left.

SPEED

While the experienced operator requires only about three seconds to make the average multiplication (three digits by four digits), it is not necessary to go through a long period of instruction before one can operate the machine fast enough to produce satisfactory results. By operating the Calculator slowly at the rate of six to eight seconds per calculation, multiplications are performed many times faster than by the pencil method.

A good operating speed for a beginner is about three key strokes per second. Due to the ease and speed of the Calculator, there is always an urge to operate the machine faster; therefore, speed picks up considerably after a few hours of practice.

METHOD OF OPERATION

The arm should be held slightly above the keyboard with the fingers in a curved position.

The wrist should be flexible and allowed to move freely while operating.

The fingers should be lifted slightly above the keytops after each stroke.

TWO HANDS USED

In most cases, two hands are used to depress—at the same time—all the keys for the amount to be multiplied. In multiplying 267, the 2 is held with the first finger of the left hand and the 6 and 7 are held with the first and second fingers of the right hand.



Two-hand operation—267

RHYTHMICAL ACTION

A smooth rhythmical operation is just as important in multiplying as in adding. Both hands should move in unison when performing the same operation. In shifting the amount being multiplied from column to column, there should be no pause in the rhythm.

A good practice problem to obtain correct rhythmical action is to multiply 44×5 across the entire keyboard, beginning at the right. Hold 44 in columns 1 and 2, using the first finger of each hand and operate five times. Move the fingers to columns 2 and 3 and operate five times. Continue across the keyboard without allowing a break in the rhythmical action.

In practicing, strive to maintain the same rhythmical action that is followed in adding. Although most of the amounts shown below would normally be held on the keyboard with one hand, use the first finger of each hand for practice purposes so as to accustom the left-hand to move in unison with the right.

1. 56×72

4. 56×76

7. 41×48

10. 56×66

2. 45×45

5. 37×75

8. 75×62

11. 30×67

3. 78×23

6. 96×49

9. 69×26

12. 45×89

HOLDING FIGURE COMBINATIONS

The factor to be held on the keyboard is determined by:

First, the ease and accuracy with which the amount can be held, and

Second, by the number of key depressions represented.

Example: 4345×8239 . Since 4345 can be held more easily than 8239, it is usually best to hold 4345, even though 22 key depressions are required as compared with 16 if 8239 were held.

Simple Rule for Fingering

Use the *longest* finger on the *highest* figure.

Figure Combinations Analyzed

By a simple analysis of figure combinations, the holding of the key factor may be greatly simplified. Those positions on the keyboard that are most easily held are *natural* combinations, while those that require a turn of the hand in order to place the fingers on the proper keys are *reverse* combinations.



Natural combination—6556

Natural Fingering

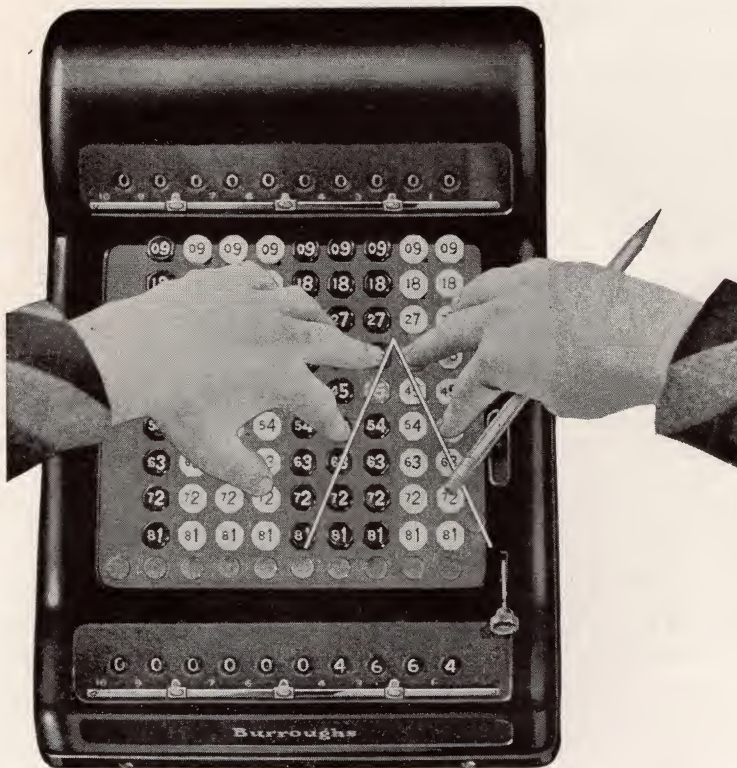
Natural fingering positions for the right hand are 35, 56, 57, 79, etc.

Natural fingering positions for the left hand are 53, 65, 75, 97, etc.

6556 is therefore a *natural* left- and right-hand combination. (See illustration at left.)

EXAMPLES OF NATURAL COMBINATIONS

1. 535×257 _____
2. 715×624 _____
3. 479×745 _____
4. 312×256 _____
5. 634×578 _____
6. 878×657 _____
7. 759×867 _____
8. 329×437 _____
9. 424×759 _____
10. 512×256 _____



Reverse combination—4664

Cross Hand Combinations

By holding reverse combinations with the hands crossed, the fingering becomes natural as illustrated at the right for 20387. The 203 is held with the right hand and the 87 with the left.

EXAMPLES OF CROSS HAND COMBINATIONS

1. 128 × 791 _____
2. 5821 × 782 _____
3. 187 × 571 _____
4. 7943 × 2398 _____
5. 298 × 186 _____
6. 5732 × 2375 _____
7. 298 × 672 _____
8. 1298 × 4697 _____
9. 348 × 239 _____
10. 5631 × 349 _____

Reverse Fingering

By referring to the accompanying illustration it may be seen that in holding 4664 the higher keys are held with the longer fingers. This necessitates turning the hand outward and raising the elbows slightly. Such combinations are classified as "Reverse."

EXAMPLES OF REVERSE COMBINATIONS

1. 2453 × 365 _____
2. 487 × 297 _____
3. 465 × 2531 _____
4. 583 × 362 _____
5. 276 × 3696 _____
6. 762 × 642 _____
7. 3698 × 274 _____
8. 976 × 651 _____
9. 751 × 5754 _____
10. 1331 × 241 _____



Cross hand operation—20387

Interposed Combinations

The holding of many combinations may be simplified by interposing the fingers. This is shown in the accompanying picture. In holding 273 the 7 is held by the left hand and the 2 and 3 are held by the right hand. In holding 391 the 9 is held by the right and the 3 and 1 are held by the left hand.

EXAMPLES OF INTERPOSED COMBINATIONS

1. 294 × 928 _____
2. 592 × 391 _____
3. 3791 × 292 _____
4. 8173 × 829 _____
5. 927 × 592 _____
6. 728 × 919 _____
7. 717 × 494 _____
8. 819 × 291 _____
9. 3618 × 491 _____
10. 393 × 493 _____



Interposed operation—273

PROVING SIMPLE MULTIPLICATION

After obtaining the product of two factors, reverse the factors, i. e., use the other factor as the keyboard factor, and re-multiply. This will detect errors due to mental transposition of figures or mechanical mis-operation of the machine, such as operating the wrong keys or operating them the wrong number of times.

MULTIPLICATION OF DECIMALS (Right to Left)

Multiplication of decimals is accomplished in the same manner as the multiplication of whole numbers.

The decimal pointers on the machine are used to indicate the decimal point in the result. *Point off*, before multiplying, as many places from the extreme right as there are decimal places in *both* factors.

Example: 6.25×3.75 equals 23.4375.

EXAMPLE PROBLEMS (Carry answers to nearest third decimal*)

- | | |
|---------------------------|------------------------|
| 1. 415.6 × .03225 _____ | 6. .4052 × 79.24 _____ |
| 2. .0005787 × 235.8 _____ | 7. 689. × .6599 _____ |
| 3. .0578 × 643.1 _____ | 8. 64.42 × 54.53 _____ |
| 4. .9677 × 42.678 _____ | 9. 36.25 × 2.75 _____ |
| 5. 3.97 × 74.57 _____ | 10. .356 × 1.99 _____ |

*If the fourth decimal in the product is 5 or more, add one to the third decimal of the answer.

MULTIPLICATION from Left to Right

When the product of two factors containing decimals may exceed the capacity of the machine, the multiplication should be made from left to right instead of from right to left. One figure at a time is dropped from the key factor at the right side of the keyboard. This may affect the accuracy of the answer *two* places from the right of the machine. However, these two places can usually be omitted without affecting the commercial value of the answer.

Pointing Off Left to Right

Beginning at the extreme left, point off to the right one place for *each whole number* and to the *left one place* for each preceding cipher in both factors. (When there are neither whole numbers nor preceding ciphers, the point remains at the extreme left.)

Example: 25.6×7.4

There are three whole numbers, therefore the decimal point is three places from the extreme left. Answer 189.44.

Example: $25.6 \times .074$

There are two whole numbers and one preceding cipher, hence the decimal point is one place from the extreme left. Answer 1.8944.

Example: $.256 \times .74$

There are neither whole numbers nor preceding ciphers and the decimal point is therefore at the extreme left. Answer .18944.

Example: $.0256 \times .0074$

There are three preceding ciphers. The decimal point is two places to the left of the machine and must be provided for in writing the answer. Answer .00018944.

After pointing off, the preceding ciphers are disregarded. In the last example 256 is held at the extreme left and multiplied by 7-4. The answer dials show 18944. The three preceding ciphers are entered when copying the result.

EXAMPLE PROBLEMS (Carry answers to nearest third decimal*)

1. 974.34625×65.35 _____
2. 2434.6143×7.97 _____
3. $1890.7525 \times .000525$ _____
4. $275.47254 \times .0000789$ _____
5. $653 \times .56858669$ _____

*If the fourth decimal in the product is 5 or more, add one to the third decimal of the answer.

MULTIPLICATION OF COMMON FRACTIONS

Common fractions are converted to their decimal equivalents and multiplied in the regular way. Most operators commit to memory the decimal equivalents of eighth and twelfth fractions because they are frequently used. Others use a table conveniently placed at the left of the keyboard for easy reference.

Example: $3 \frac{1}{4} \times 6 \frac{5}{8}$ Multiply left to right $3.25 \times 6.625 = \text{Answer } 21.53125$.

EIGHTHS		TWELFTHS		EXAMPLE PROBLEMS	
1/8	.125	1/12	.08333	1.	$679. \times 4 \frac{1}{8}$ _____
2/8 or 1/4	.25	2/12 or 1/6	.16667	2.	$9.67 \times 5 \frac{7}{12}$ _____
3/8	.375	3/12 or 1/4	.25	3.	$9.08 \times 10 \frac{5}{8}$ _____
4/8 or 1/2	.5	4/12 or 1/3	.33333	4.	$95 \frac{3}{4} \times 75 \frac{7}{8}$ _____
5/8	.625	5/12	.41667	5.	$.235 \times 765 \frac{6}{12}$ _____
6/8 or 3/4	.75	6/12 or 1/2	.5	6.	$1975. \times 3 \frac{11}{12}$ _____
7/8	.875	7/12	.58333	7.	$29.55 \times 45 \frac{4}{12}$ _____
		8/12 or 2/3	.66667	8.	$3015. \times 4 \frac{1}{6}$ _____
		9/12 or 3/4	.75	9.	$226.25 \times 7/8$ _____
		10/12 or 5/6	.83333	10.	$11.75 \times 65 \frac{3}{8}$ _____
		11/12	.91667		

MULTIPLICATION OF LARGE AMOUNTS—SPLIT MULTIPLICATION

Multiplications in business seldom exceed three digits by four digits. Occasionally, however, problems are found in which the amounts are too large to be conveniently held on the keyboard. In such cases, the key factor is split and the multiplication is made in two steps.

It is good practice to split the key factor as follows:

1. Take the first *three* figures at the *left* of an amount and multiply by the other factor from left to right. Leave the answer on the dials.

2. Take the remaining figures of the key factor (beginning in the fourth column from the left-hand side) and multiply by the other factor.

Example: $42935 \times 39234 : 42900 \times 39234$ and $35 \times 39234 = 1684511790$.

A similar procedure may be followed in multiplying from right to left.

EXAMPLE PROBLEMS (Carry answers to nearest third decimal*)

1. 79.3821×719.34 _____
2. 3.56839×541.758 _____
3. 56.3926×65.3462 _____
4. 675.534×86.7139 _____
5. 3.38459×658.719 _____

*If the fourth decimal in the product is 5 or more, add one to the third decimal of the answer.

FIXED DECIMAL POINT

For convenience in operating, place a decimal pointer at 5, (between the white and black keys in columns 5 and 6) to be used as a fixed decimal point. The columns at the left of the split are for dollars and those at the right for cents and fractions of a cent. However, bear in mind that a fixed decimal point can be established at any position on the Calculator.

Always Hold the Price

First, hold the price—*the value of one*—in the correct relation to the fixed decimal point.

1. If there are no fractions in the quantity, multiply from right to left.

Example: 25 articles at \$3.25 each.

Operation: Hold the price, \$3.25 in the correct relation to the fixed decimal point, as explained above, and operate five times; move one place to the left and operate twice. The answer, \$81.25, is pointed off automatically.

2. When the quantity consists of whole numbers and fractions (as $35\frac{1}{2}$), place the fingers on the price, in the units position; then move one place to the left for tens, two places for hundreds, etc. Multiply from left to right.

Example: $354\frac{1}{4}$ yards at \$3.25 per yard.

Position: Hold the price, \$3.25, in the units position. Move two places to left for the starting point.

Operation: Multiply from left to right by 3-5-4-2-5. The answer, \$1151.31, is pointed off automatically.

3. When the quantity is fractional (as .75), move to the right for the first figure of value—one place for tenths, two places for hundredths, etc.—then multiply from left to right.

Example: $\frac{3}{4}$ (.75) article at \$3.25 each.

Position: Hold the price, \$3.25, in the units position. Move one place to the right for the starting point.

Operation: Multiply from left to right by 7-5. The answer, \$2.44, is pointed off automatically.

Example: .025 article at \$3.25 each.

Position: Hold the price, \$3.25, in the units position. Move two places to the right for the starting point.

Operation: Multiply from left to right by 2-5. The answer, \$.08, is pointed off automatically.



FIXED DECIMAL POINT ACCUMULATION

When several items are extended without clearing the machine, the sum of the results is automatically accumulated. This is a method commonly used for checking invoices.

Example: Extend the following invoice and then check by accumulation:

5	Pieces @ \$ 1.35 each	\$ 6.75
25	Pieces @ .75 each	_____
5½ (5.5)	Pieces @ .48 each	_____
7¼ (7.25)	Pieces @ 20.00 each	_____
24½ (24.5)	Pieces @ 2.06 each	_____
106	Pieces @ .075 each	_____

		\$231.56

When a single dial Calculator is used and fractions are dropped or gained in the individual extensions, the proof by accumulation will differ accordingly. When a Duplex Calculator is used, each extension is carried to the nearest full cent and any fractions of cents are dropped in the accumulation; thus the accumulated total should balance exactly with the invoice total.

The fixed decimal point should be at position 5 when the Duplex Calculator is used. Then, to convert the result of a calculation to the nearest full cent, it is only necessary to depress the 5 mills key. By having the "Decimal Non-transfer Key" (a red key at the right of the keyboard) latched down, only the full-cent amount will be transferred to the accumulator when the transfer bar is used.

Advantages of Electric Duplex Calculator on Fixed Decimal Point Accumulation.

1. Eliminates re-addition for the grand total, when the result of each extension is desired.
2. Eliminates possibility of grand totals not balancing with the total of individual calculations due to fractions lost or gained in accumulations. (Full cent mechanism converts individual extensions to nearest full cent and automatically drops fractional cents in the accumulation.)
3. Localizes an error to one extension when checking an invoice. Otherwise it might be necessary to re-calculate the entire invoice in case the grand total did not agree with the previous grand total.

FIXED DECIMAL POINT ACCUMULATION

EXAMPLE PROBLEMS

Always Hold the Price as the Key Factor

Extend the following invoices and check by accumulation.

- | | |
|---|--|
| <p>1. 14 doz. @ \$3.12½ per doz. _____</p> <p>35 doz. @ .76¾ per doz. _____</p> <p>17¼ doz. @ .33 per doz. _____</p> <p>6⅓ doz. @ 1.12½ per doz. _____</p> <p>15⅓ doz. @ .64 per doz. _____</p> <p style="text-align: right;">Total.</p> | <p>3. 64⅞ lbs. @ \$.09 per lb. _____</p> <p>75½ lbs. @ .65 per lb. _____</p> <p>4¾ lbs. @ .72¾ per lb. _____</p> <p>38½ lbs. @ .65 per lb. _____</p> <p>19⅞ lbs. @ .86¼ per lb. _____</p> <p style="text-align: right;">Total.</p> |
| <p>2. 2½ yds. @ 1.65 per yd. _____</p> <p>308¼ yds. @ .41½ per yd. _____</p> <p>95½ yds. @ 8.36 per yd. _____</p> <p>36⅝ yds. @ .17½ per yd. _____</p> <p>19⅜ yds. @ .09¼ per yd. _____</p> <p style="text-align: right;">Total.</p> | <p>4. 54 yds. @ .07½ per yd. _____</p> <p>37 yds. @ .05¾ per yd. _____</p> <p>17 yds. @ 1.25 per yd. _____</p> <p>45 yds. @ .74½ per yd. _____</p> <p>39 yds. @ .31¾ per yd. _____</p> <p style="text-align: right;">Total.</p> |

Articles Priced by the 100, 1000, and Hundredweight

Pointing off 2 places in the quantity divides by 100; pointing off 3 places divides by 1000; thus $1741 \div 100 = 17.41$; $7986 \div 1000 = 7.986$.

Example: 1741 pcs. @ 14.50 per C. Multiply $17.41 \times \$14.50 = \252.45 .

EXAMPLE PROBLEMS

WORK OVER FIXED DECIMAL POINT—RECALCULATE TO PROVE

- | | | | | |
|-------------|-----------|------|--------------|-------|
| 1. | 19587 | @ \$ | .43 per M | _____ |
| 2. | 4732 | @ | 4.85 per M | _____ |
| 3. | 2567 | @ | .75 per M | _____ |
| 4. | 9876 | @ | .25 per M | _____ |
| 5. | 5765 | @ | 5.00 per M | _____ |
| 6. | 8676 lbs. | @ | .98 per Cwt. | _____ |
| 7. | 2343 | @ | 9.85 per M | _____ |
| 8. | 898 | @ | .75 per C | _____ |
| 9. | 625 | @ | 15.75 per C | _____ |
| 10. | 9899 | @ | 14.75 per M | _____ |
| Total. | | | | _____ |

COMPOUND MULTIPLICATION (Stroke Wheel Method)

When one factor is on the dials as a result of a previous calculation and is to be multiplied by another factor, the multiplication is made by the "stroke wheel method" to save clearing the machine and writing down answers. This method is also used when amounts are being called as one factor may be entered immediately in the dials so as to avoid forgetting it.



Over the left figure

35) is held so that the 4 is over the 1 in the dials and is multiplied from left to right by the figures shown in the dials. Answer, \$656.25.

Consider the Factor on the Dials as Multiplied Once. POINT OFF as many places from the extreme right as there are decimal places in all factors.

Operation

Hold the other factor, large figures *less one*, so its *right-hand* digit is over the *left-hand* digit of the amount in the dials.

Multiply from left to right. The dials show the number of strokes to be taken in each column.

Example: 35 bolts, 25 yards each, at \$.75 a yard. After multiplying \$.75 by 25, the result in the dials, \$18.75, is not cleared. Then 34 (1 less than

EXAMPLE PROBLEMS

RECALCULATE TO PROVE

1. 63 bolts 48 yards @ \$.76 a yard _____
 2. 37 bolts 52 yards @ 2.50 a yard _____
 3. 43 bolts 56 yards @ 1.80 a yard _____
 4. 24 bolts 52 yards @ 1.38 a yard _____
 5. 53 bolts 18 yards @ .25 a yard _____
 6. 62 boxes 24 pieces @ .18 a piece _____
 7. 48 boxes 36 pieces @ .45 a piece _____
 8. 35 boxes 12 pieces @ .70 a piece _____
 9. 40 boxes 48 pieces @ .65 a piece _____
 10. 48 boxes 54 pieces @ .85 a piece _____
- Total.....

TRADE DISCOUNT

Trade discounts provide for fluctuations in prices and at the same time enable the manufacturer or dealer to use established list prices as the basis for quotations.

TO FIND THE AMOUNT OF THE DISCOUNT

The amount of discount is found by multiplying the gross amount by the discount per cent. The operation may be performed as a simple multiplication from right to left, or, if the gross amount is on the dials, the Stroke Wheel Method may be used.

Example: Find 65% (.65) discount on a gross bill of \$425.

Operation: Point off two places and multiply \$425 by .65. Answer: \$276.25.

TO FIND THE NET AMOUNT

The gross amount is entered at the right of the keyboard and then multiplied by the discount per cent, using the small figures on the key tops. The stroke wheel method of multiplying is followed except that *one is not deducted* from the key factor. The product will be the net amount. By using the small figures in this manner, the amount of the discount is subtracted from the gross amount as the calculation is made. Point off according to the rule for multiplication of decimals. Additional discounts may be deducted in the same manner.

EXAMPLE PROBLEMS

	Gross	Amt. of Discount	Net
1. 265 articles @ \$ 2.75 each less 25% =	_____	_____	_____
489 articles @ 9.95 each less 14% =	_____	_____	_____
525 articles @ 4.59 each less 45% =	_____	_____	_____
964 articles @ 7.50 each less 40% =	_____	_____	_____
16 articles @ 60.75 each less 35% =	_____	_____	_____
Total	_____	_____	_____
2. 150 articles @ \$10.69 each less 15% =	_____	_____	_____
745 articles @ 76.68 each less 65% =	_____	_____	_____
757 articles @ 9.13 each less 5% =	_____	_____	_____
68 articles @ 15.70 each less 30% =	_____	_____	_____
75 articles @ 7.35 each less 29% =	_____	_____	_____
Total	_____	_____	_____

SUCCESSIVE OR CHAIN DISCOUNTS

Problem: \$18.75 less 65-20-5%.

Operation: Place \$18.75 in the dials.

First—Hold *small* 65 and perform a Stroke Wheel Multiplication. The dials will show \$6.5625.

Second—Hold *small* 20 and multiply as before. The dials will show \$5.25.

Third—Hold *small* 05 and perform a Stroke Wheel Multiplication.

Answer: \$4.99.

When nines occur in the discount, omit them and hold the remaining figures. Examples: For 90, hold small cipher only; for 95, hold small five only; for .09, hold small cipher only; for .19, hold small one.

A chain discount may be computed in any order. For example, 60-10-5% is the same as 5-10-60%.

EXAMPLE PROBLEMS

SUCCESSIVE DISCOUNT METHOD

	Gross	Amt. of Discount	Net
3. 34 articles @ \$ 1.57 each less 15-10% =	_____	_____
50 articles @ 10.50 each less 15-12½% =	_____	_____
16 articles @ 4.89 each less 45-30-15% =	_____	_____
140 articles @ 6.35 each less 15-5% =	_____	_____
45 articles @ 5.56 each less 35-20% =	_____	_____
Total	_____	_____

NET DECIMAL EQUIVALENT METHOD OF FIGURING CHAIN DISCOUNTS

When a series or chain of discounts is used frequently, the operation may be shortened by multiplying the gross amount by the net decimal equivalent of the series of discounts, usually obtained from a table (see next page).

Example: Find the net amount of \$425.00 less 65-10-10%.

The net decimal equivalent of 65-10-10% is .2835.

Operation: $\$425 \times .2835 = \120.49 .

Finding Net Decimal Equivalents

When the desired net decimal equivalent is not available in a table, it may be found by stroke wheel multiplication as described above, using 1 as the gross amount.

Example: Find the net decimal equivalent of 45-35-20-5%.

Operation: *Use the small figures on the keys.*

Set a decimal pointer as many places from the right as there are decimal places in all the key factors. The discount 45-35-20-5% equals .45-.35-.20-.05, when expressed decimally. The pointer should, therefore, be moved to the left eight places.

First —Add 1 in the first column from the right.

Second—Hold small 45 and depress the keys once. The dials will then show 55.

Third —Hold small 35 and depress the keys the number of times indicated by the dials, as in stroke wheel multiplication. The dials will then show 3575.

Fourth—Hold small 20 and depress the keys the number of times indicated by the dials. The dials will then show 286000.

Fifth —Hold small 05 and depress the keys the number of times indicated by the dials. The dials will then show 27170000.

The answer, .2717, is the net decimal equivalent.

EXAMPLE PROBLEMS

NET DECIMAL EQUIVALENT METHOD

	Gross	Amt. of Discount	Net
4. 250 articles @ \$35.50 each less 75-10% =	_____	_____
187 articles @ 6.25 each less 25-10-10% =	_____	_____
45 articles @ 2.25 each less 90-10-5% =	_____	_____
450 articles @ 5.66 each less 10-10-2½% =	_____	_____
74 articles @ 3.44 each less 60-10-10-5-2½% =	_____	_____
Total	_____	_____

**Table of
NET DECIMAL EQUIVALENTS OF CHAIN DISCOUNTS**

Rate %	5	7½	10	12½	15	16⅔	20	\$ 25	30	33⅓	35	37½
Net	.95	.925	.90	.875	.85	.83333	.80	.75	.70	.66667	.65	.625
2½	.92625	.90188	.8775	.85313	.82875	.8125	.78	.73125	.6825	.65	.63375	.60938
5	.9025	.87875	.855	.83125	.8075	.79166	.76	.7125	.665	.63333	.6175	.59375
5 2½	.87994	.85678	.83363	.81047	.78731	.77187	.741	.69469	.64838	.6175	.60206	.57891
5 5	.85738	.83481	.81225	.78969	.76713	.75208	.722	.67688	.63175	.60167	.58663	.56406
5 5 2½	.83594	.81394	.79194	.76995	.74795	.73328	.70395	.65995	.61596	.58663	.57196	.54996
7½	.87875	.85563	.8325	.80938	.78625	.77083	.74	.69375	.6475	.61667	.60125	.57813
7½ 2½	.85678	.83423	.81169	.78914	.76659	.75156	.7215	.67641	.63131	.60125	.58622	.56367
7½ 5	.83481	.81284	.79088	.76891	.74694	.73229	.703	.65906	.61513	.58583	.57119	.54922
10	.855	.8325	.81	.7875	.765	.75	.72	.675	.63	.6	.585	.5625
10 2½	.83363	.81169	.78975	.76781	.74588	.73125	.702	.65813	.61425	.585	.57038	.54844
10 5	.81225	.79088	.7695	.74813	.72675	.7125	.684	.64125	.5985	.57	.55575	.53438
10 5 2½	.79194	.7711	.75026	.72942	.70858	.69469	.6669	.62522	.58354	.55575	.54186	.52102
10 7½	.79088	.77006	.74925	.72844	.70763	.69375	.666	.62438	.58275	.555	.54113	.52031
10 10	.7695	.74925	.729	.70875	.6885	.675	.648	.6075	.567	.54	.5265	.50625
10 10 5	.73103	.71179	.69255	.67331	.65408	.64125	.6156	.57713	.53865	.513	.50018	.48094
10 10 5 2½	.71275	.69399	.67524	.65648	.63772	.62522	.60021	.5627	.52518	.50018	.48767	.46891
Rate %	40	50	60	62½	65	66⅔	70	75	80	85	87½	90
Net	.60	.50	.40	.375	.35	.33333	.30	.25	.20	.15	.125	.10
2½	.585	.4875	.39	.36563	.34125	.325	.2925	.24375	.195	.14625	.12188	.0975
5	.57	.475	.38	.35625	.3325	.31667	.285	.2375	.19	.1425	.11875	.095
5 2½	.55575	.46313	.3705	.34734	.32419	.30875	.27788	.23156	.18525	.13894	.11578	.09263
5 5	.5415	.45125	.361	.33844	.31588	.30083	.27075	.22563	.1805	.13538	.11281	.09025
5 5 2½	.52796	.43997	.35198	.32998	.30798	.29331	.26398	.21998	.17599	.13199	.10999	.08799
7½	.555	.4625	.37	.34688	.32375	.30833	.2775	.23125	.185	.13875	.11563	.0925
7½ 2½	.54113	.45094	.36075	.3382	.31566	.30063	.27056	.22547	.18038	.13528	.11273	.09019
7½ 5	.52725	.43938	.3515	.32953	.30756	.29292	.26363	.21969	.17575	.13181	.10984	.08788
10	.54	.45	.36	.3375	.315	.3	.27	.225	.18	.135	.1125	.09
10 2½	.5265	.43875	.351	.32906	.30713	.2925	.26325	.21938	.1755	.13163	.10969	.08775
10 5	.513	.4275	.342	.32063	.29925	.285	.2565	.21375	.171	.12825	.10688	.0855
10 5 2½	.50018	.41681	.33345	.31261	.29177	.27788	.25009	.20841	.16673	.12504	.1042	.08336
10 7½	.4995	.41625	.333	.31219	.29138	.2775	.24975	.20813	.1665	.12488	.10406	.08325
10 10	.486	.405	.324	.30375	.2835	.27	.243	.2025	.162	.1215	.10125	.081
10 10 5	.4617	.38475	.3078	.28856	.26933	.2565	.23085	.19238	.1539	.11543	.09619	.07695
10 10 5 2½	.45016	.37513	.30011	.28135	.26259	.25009	.22508	.18757	.15005	.11254	.09378	.07503

This table is available on a separate card, Form C 1030.

Decimal equivalents not shown on this table may be found as follows:

Rule—Multiply the complements of the discount rates. The product will be their **net** decimal equivalent.

Problem: Find the **net** decimal equivalent of 45-20-10%.

Discounts: .45—.20—.10

Complements: .55×.80×.90=.396, Net Decimal Equivalent.

MIXED ITEM EXTENSIONS OVER A FIXED DECIMAL POINT

On a Burroughs Duplex Calculator, mixed items may be extended over a fixed decimal point, and a grand total of the items obtained *without* recapping. Each item is handled so that the net result of each extension will be in the lower dials with the fixed decimal point at 5. Discounts and divisions (by dozens, gross, etc.) which will affect the position of the decimal point, must therefore be compensated for in the first operation of multiplying the price by the quantity.

Example

15 doz. articles at .87 per dz., less 20%	\$10.44
7 doz. articles at 1.45 per dz., less 15% & 25%	6.47
15 only at 2.50 per gross, net	.26
16 $\frac{3}{4}$ doz. at .15 each	30.15
1 $\frac{1}{4}$ gross at .08 $\frac{1}{2}$ each	15.30
$\frac{3}{4}$ gross at .07 each	7.56
	<hr/>
	\$70.18

First Item

Hold the price one place to the right of the fixed decimal point and multiply by the quantity in the usual way. Hold the figures in the lower dials (1305) over themselves and multiply left to right by the complement of the discount less 1 in the left-hand digit of the complement (80 less 1 at the left = 70). The answer, properly pointed off, is 10.44. Transfer to rear dials.

Second Item

Hold the price two places to the right of the fixed decimal point (one place for each discount) and multiply by the quantity in the usual way. Hold the figures in the lower dials (1015) over themselves and multiply left to right by the complement of the first discount per cent less 1 in the left-hand digit (85 less 1 at the left = 75). Then hold the dial figures (86275) over themselves and multiply left to right in the same manner by the complement of the second (75 less 1 at the left = 65). The answer, properly pointed off, is 6.47. Transfer to rear dials.

Third Item

The quantity is 15 and the divisor is 144. *Visualize* a decimal point in the quantity as many places to the left as there are whole numbers in the divisor. The quantity now becomes .015. Multiply over the fixed decimal point \$2.50 by .015 and divide the result by 144. The answer, properly pointed off, is .26. Transfer to rear dials.

Fourth Item

Multiply over the fixed decimal .15 \times 12 (cost of 1 doz.). Hold the figures in the lower dials (1.80) over themselves, move one place to the left and multiply left to right by 15.75. The answer, properly pointed off, is 30.15. Transfer to rear dials.

Fifth Item

Multiply over the fixed decimal .085 \times 144 (cost of 1 gross). Hold the figures in the lower dials (12.24) over themselves, move one place to the right and multiply by 25. The answer, properly pointed off, is 15.30. Transfer to rear dials.

Sixth Item

Since the quantity is a fraction, hold .07 one place to the right of the normal position, over the fixed decimal. Multiply by 144. The dials read 1.008. Hold 1.008 over itself and multiply from left to right by 65. The answer, properly pointed off, is 7.56. Transfer to rear dials.

GRAND TOTAL in rear dials, 70.18

Note: Whenever there is a large number of dozen and gross extensions, use a decimal equivalent table, Form C 1022, instead of the dividing operation.

Note: When the net decimal equivalent of a chain discount is used, the extension is made in the same manner as for a single discount, i. e., subtract 1 from the left-hand digit of the net decimal equivalent. If the complement of a discount or the net decimal equivalent of a chain discount is less than 10%, hold the price two places instead of one to the right of the fixed decimal point.

Practice Problem

26 $\frac{3}{4}$ doz. at .15 each	48.15
3 $\frac{1}{2}$ gr. at 2.15 per gr. less 12 $\frac{1}{2}$ % (.875)	6.58
76 only at 4.40 per gr.	2.32
171 only at .45 per dz.	6.41
$\frac{3}{4}$ gr. at .07 $\frac{1}{2}$ each	8.10
3 $\frac{1}{2}$ dz. at 1.25 per dz. less 33 $\frac{1}{3}$ -10-10% (.54)	2.36
21 $\frac{1}{4}$ gr. at .06 $\frac{1}{2}$ each	198.90
	<u>\$272.82</u>

ACCUMULATING NET AMOUNTS FROM CHAIN DISCOUNT CALCULATIONS

When the net decimal equivalent of a chain discount is used, the price is held one place to the right of the fixed decimal point and multiplied by the quantity. Then the figures in the lower dial are held over themselves and multiplied, left to right, by the net decimal equivalent, *less 1 in the left-hand digit of the equivalent per cent.*

7 dozen at \$4.50 per doz., less 15-10% (.765)	_____
12 dozen at \$3.25 per doz., less 20-5% (.76)	_____
12 only, at \$.75 each, less 10-5% (.855)	_____
15 only, at \$.87 $\frac{1}{2}$ each, less 10-10% (.81)	_____
Total.....	_____

PROVING MULTIPLICATIONS

Because of the human element, practically all calculating and accounting procedure includes some means of proving the accuracy of the work. This is accomplished by handling each factor twice in some manner.

Errors may result either from poor legibility of the figures or from carelessness. Also, after a correct calculation, an error may be made in recording the result. Proof of accuracy is best obtained by recalculating either by the same operator after a number of calculations have been made, or by another operator. When a calculation is checked immediately after it has been made, there is the possibility of checking against the memory of the figures rather than the actual figures.

SUBTRACTION

There is only one rule for subtraction on the Burroughs Calculator, regardless of the combination of figures:

Depress the subtract control key in the column immediately to the left of the amount to be subtracted and then depress the amount, less one, in small figures.

Examples:

$$\begin{array}{r} .75 \\ - .56 \\ \hline .19 \end{array} \qquad \begin{array}{r} 5,000,000.45 \\ - .56 \\ \hline 4,999,999.89 \end{array}$$

Nines are automatic when using the small figures in the same sense that ciphers are automatic when using the large figures.

Examples: (In the following, "S" represents the subtraction control key immediately to left of amount being subtracted and "X" represents a nine for which no key is operated).

To Subtract— Depress—

44	S43 (small figures)
275	S274 (small figures)
2705	S2704 (small figures)
295	S2X4 (small figures)
95	SX4 (small figures)
200	S1XX (small figures)

CREDIT BALANCES

A credit balance, or negative total, occurs when the total of the credits (subtracted amounts) exceeds the total of the debits (added amounts). When a credit balance occurs, it is shown in the dials as a complementary amount, with nines appearing to the left.



Subtracting 44 from 290



A credit balance of 32 shown as a complement

To Convert a Complementary Total to a True Credit Balance

Hold the dial amount, less one, on the small figures. Depress the keys twice. If the correct keys are held, the first operation will clear the machine and the second operation will show the true credit balance.

Example: 28
 72 -
 36
 24 -

Dials show 999999968 (Hold 67 on the small figures directly over the 68 and depress the keys twice.) Answer 32 Cr.

EXAMPLE PROBLEMS

- | | | | | |
|--------|--------|--------|----------|----------|
| 1. .75 | 2. .63 | 3. .41 | 4. .12 - | 5. .54 - |
| .89 - | .42 - | .98 - | .75 - | .63 |
| .44 | .75 | .22 - | .24 - | .72 - |
| .98 - | .28 - | .84 - | .63 | .23 - |
| .28 - | .88 - | .25 | .45 | .77 |

DIRECT SUBTRACTION

Burroughs Duplex Calculators are the only key-actuated calculating machines that subtract without the use of complementary figures. An amount in the front dials may be subtracted from an amount in the rear dials merely by depressing the subtract key.

A group of amounts may be added in the front dials and transferred to the rear dials by depressing the transfer bar. Then another group of amounts may be added in the front dials and, by merely pressing the subtract key, the total of the second group may be subtracted from the total of the first group.

Individual amounts may be added in the rear dials by entering them on the keyboard and depressing the transfer bar. In the same manner individual amounts may be subtracted from the amount in the rear dials by entering them on the keyboard and depressing the subtract key.

An extension of an item in an invoice may be made and the gross amount transferred to the rear dials with the transfer bar. Then the amount of the discount may be figured and, by merely pressing the subtract key, subtracted from the gross amount, leaving the net.

EXAMPLE PROBLEMS

- | | | |
|----------------|-----------------|-----------------|
| 1. 6758 - 3090 | 8. 1007 - 359 | 15. 3742 - 3095 |
| 2. 6531 - 427 | 9. 5276 - 421 | 16. 4709 - 3794 |
| 3. 7456 - 2793 | 10. 3784 - 905 | 17. 5121 - 3529 |
| 4. 5799 - 4982 | 11. 5269 - 2046 | 18. 5761 - 3225 |
| 5. 6235 - 970 | 12. 3127 - 598 | 19. 3671 - 984 |
| 6. 5275 - 1001 | 13. 7809 - 307 | 20. 7623 - 2100 |
| 7. 6752 - 1804 | 14. 6754 - 6739 | |

DIVISION

In the average office there is, as a rule, little or no division work during the month. At the month-end there is sometimes a small amount of percentage calculations to provide comparative statistics. Rarely, however, does division work constitute more than 3 or 4 per cent of the total figure work and it is usually less.

Division is merely repeated subtraction. The answer is simply a record of the number of subtractions made. The subtractions are made from left to right, just as with the pencil-and-paper method of division.

There are two methods of dividing on the Calculator. The "cipher method" is somewhat simpler to understand and is necessary in one type of calculation (see next page). The "trial divisor" method is faster and one less key is held on the keyboard.

CIPHER DIVISION

Enter the dividend, beginning in the *next to the last column* at the left of the machine. For the divisor, use small figures, less one, and also hold the small cipher in the column to the left of the divisor amount. If the amount in the dials directly under the divisor is larger than the divisor, subtract repeatedly until it becomes smaller. Then move the key factor (divisor) one place to the right and repeat the subtraction operations as in the first position. Continue this process, moving to the right each time the remainder becomes less than the divisor. Observe the similarity to the lead-pencil method. As the subtractions are made, the answer, which is the number of subtractions made, is recorded in the dials to the left. The small cipher which is held to the left of the divisor causes the answer to be separated from the remainder in the dials.

Always point off before dividing. To simplify pointing off in cipher division, *begin one place to the left of the dividend decimal point* and then move the pointer one place to the left for each whole number or one place to the right for each preceding cipher in the divisor. If the divisor contains neither whole numbers nor preceding ciphers, the point is not moved.

EXAMPLE PROBLEMS

1. $23065 \div 35$ _____

2. $23534 \div 41$ _____

3. $31584 \div 56$ _____

4. $26727 \div 59$ _____

5. $163.995 \div 37.7$ _____

6. $20.61 \div 22.5$ _____

7. $56.0077 \div 8.99$ _____

8. $9222. \div 636.$ _____

9. $168.285 \div 8.63$ _____

10. $132.822 \div 4.92$ _____

ADDING AND CONVERTING MIXED DENOMINATIONS

The "cipher" method of division is useful for converting the lower denomination to the higher after adding such amounts as hours and minutes, bushels and pounds, feet and inches, whole numbers and common fractions, etc., on a machine without a fraction keyboard.

For example, pounds may be added on the section of white keys in the sixth to eighth column, and ounces on the section of black keys in the third to fifth column.

To illustrate the method, add 48 ounces on the black keys at the right. Then hold small 15 (one less than 16) with one cipher at the left, as 015.

Note that as the keys are depressed, one unit (one pound) will be recorded in the units of pounds column. The completion of the operation shows three pounds.

Place 60 on the dials as 60 ounces, divide by 16, with a cipher at the left. When the remainder shows 12, move the divisor one place to the right and continue to divide. Move over again and complete the division. Answer: 3.75 pounds. Thus, 60 ounces have been converted to pounds and the decimal of a pound.

The same process is involved in converting all mixed denominations. Example: Find the value of 35 bushels and 18 pounds of oats at 89¢ per bushel. Operation: Add the 35 in three columns of white keys, and the 18 in the three columns of black keys. Set a decimal pointer between the fifth and sixth columns. Convert the pounds to bushels, and a fraction of a bushel by dividing by 32, the number of pounds in a bushel of oats. Multiply by the price, stroke wheel method, being careful to exclude the remainder, if any, from the operation. Where the problem is too large for the capacity of the machine, note answer on dials, and extend after clearing the machine. Answer: \$31.65.

Example Problems:

GRAIN

Add the following and convert pounds to bushels, carrying the fractions of a bushel to three decimal places.

Wheat, 60 lbs.

52 bu. 49 lbs.

56 bu. 55 lbs.

63 bu. 18 lbs.

Corn, 56 lbs.

72 bu. 23 lbs.

26 bu. 53 lbs.

28 bu. 46 lbs.

Oats, 32 lbs.

19 bu. 27 lbs.

11 bu. 24 lbs.

25 bu. 18 lbs.

YARDAGE

Add fractions in the following problems as eighths and convert:

28 $\frac{4}{8}$ yards

15 $\frac{5}{8}$ yards

22 $\frac{7}{8}$ yards

23 $\frac{4}{8}$ yards

26 $\frac{3}{8}$ yards

28 $\frac{2}{8}$ yards

45 $\frac{5}{8}$ yards

37 $\frac{4}{8}$ yards

26 $\frac{6}{8}$ yards

HOURS AND MINUTES

Add the following and convert minutes to hours, carrying the decimal of an hour to tenths only:

7 hrs. 10 min.

7 hrs. 15 min.

7 hrs. 20 min.

8 hrs. 10 min.

9 hrs. 15 min.

9 hrs. 45 min.

9 hrs. 55 min.

8 hrs. 15 min.

8 hrs. 25 min.

8 hrs. 35 min.

8 hrs. 15 min.

8 hrs. 50 min.

TRIAL DIVISOR METHOD OF DIVISION

The first operation in the lead-pencil method of division is to "try" the divisor for the number of times it can be contained in the active dividend. Machine division follows this method in principle but instead of having to mentally estimate the number of times that the divisor can be subtracted, the trial divisor dial (located directly to the left of the divisor) automatically does this for us. The procedure for dividing on the calculator is as follows:

1. Set up the dividend (large figures) at the extreme left of the keyboard.
2. *Point off before dividing.* (Begin at the dividend decimal point.)
 - (a) Move the decimal pointer one place to the left for each whole number in the divisor. Example: Three places to the left for 745.03.
 - (b) Move one place to the right for each preceding cipher in the divisor. Example: One place to the right for .043.

If the divisor contains neither whole numbers nor preceding ciphers, do not move the decimal pointer. Example: .423.
3. Hold the divisor (small figures less one) at the extreme left of the keyboard.
4. If the divisor is not contained in the dividend figures directly below it, move one column to the right to add another dividend figure. If it is contained, subtract until it is no longer contained, then move to the right.
5. Subtract the divisor in rapid succession as many times as indicated by the trial divisor dial located at the left of the divisor. If the trial divisor dial advances, continue to subtract until the number of subtractions equals the figure in the trial divisor dial.
6. Next, reduce the remainder (the amount appearing in the dials directly under the divisor) until it is less than the divisor.
7. Move the divisor one column to the right and repeat the process.

EXAMPLE: $3465 \div 45$.

Set up 3465 (large figures) at the extreme left of the keyboard. Since there are two whole numbers in the divisor, the decimal point is moved two places to the left of the dividend decimal point position.

Hold 44 (small figures) directly over 34.

Since 45 is not contained in 34, move the divisor one column to the right to add another dividend figure.

Equal the Trial Divisor

The trial divisor dial immediately to the left of the columns in which the divisor is



TRIAL DIVISOR

Equal the Trial Divisor

held now shows 3. Subtract 45 rapidly three times.

It will be observed that the trial divisor has advanced to 5.

Continue to subtract until the number of subtractions agrees with the figure in the trial divisor dial. In this case it will be after six subtractions.

The remainder in this position is 76.

Reduce the Remainder

Reduce the remainder by further subtraction (once, in this problem) until it is less than the divisor, 45.

Move Over and Repeat

Move the divisor one column to the right to add another dividend figure. It will be over 15. The three at the left is the new trial divisor.

Operate rapidly three times, then twice more to equal the trial divisor. Operate two more times to reduce the remainder. Answer: 77.



REMAINDER
Reduce the Remainder



NEW TRIAL DIVISOR
Move Over and Repeat

EXAMPLE PROBLEMS

(CARRY ANSWERS TO THE NEAREST SECOND DECIMAL POINT)

$$\begin{array}{l} 16425 \div 25 \quad \underline{\hspace{2cm}} \\ 35438 \div 47 \quad \underline{\hspace{2cm}} \\ 60921 \div 63 \quad \underline{\hspace{2cm}} \\ 1390 \div 25.75 \quad \underline{\hspace{2cm}} \\ 83363 \div 7.35 \quad \underline{\hspace{2cm}} \end{array}$$

$$\begin{array}{l} 3160 \div 52.65 \quad \underline{\hspace{2cm}} \\ 27345 \div 5.452 \quad \underline{\hspace{2cm}} \\ 35.25 \div .47 \quad \underline{\hspace{2cm}} \\ 48.372 \div 78.004 \quad \underline{\hspace{2cm}} \\ 16.90834 \div .000358 \quad \underline{\hspace{2cm}} \end{array}$$

PRECEDING AND ENDING CIPHERS

Preceding ciphers in a divisor, as in .0035, or ending ciphers as in 3500 are considered only in pointing off. They are disregarded while dividing. For .0035 the decimal point is moved two places to the right; for 3500 it is moved four places to the left.

THE REMAINDER

When the limit of the keyboard has been reached, or when the quotient has been carried the desired number of places, the number on the dials in the column in which the divisor is held is a remainder and must not be considered a part of the quotient.

When a remainder occurs, move over and continue to divide as before until the quotient has been carried to the desired number of decimal places. After the last quotient figure is obtained, observe the remainder. If the remainder is more than half of the divisor, add one to the last quotient figure. The two right-hand dials should not be used for quotient figures.

NINES AT LEFT OF DIVISOR

When the left-hand figure in the divisor is 9, as in 95, 995, etc., the trial divisor will be one column to the left of the column in which the nine occurs.

DIVISION SHORT CUT

The modern statistician is reducing the cost of compiling statistics by carrying out averages, percentages, etc., to not more than 3 or 4 decimal places. Since this serves most practical purposes, the carrying out of decimals in a division problem beyond the actual number of places required is a needless waste of time and energy.

A Safe Rule to Follow

Use *one more figure* in the *divisor* and *dividend* than the *number of figures* desired in the answer, excluding preceding ciphers.

In pointing off, all whole numbers in the divisor must be considered although only part of the divisor is held on the keyboard.

Example:	Sales	\$46,872,392
	Profit	2,782,679

Find per cent of profit to Sales

$$\begin{array}{r} \text{Operation:} \quad 2,783,000 \\ \hline 46,870,000 \end{array} = .0594 = 5.94\%$$

Carry to three answer figures. If the remainder is over half of the divisor, increase the third answer figure by one.

$$1. \quad 3694156 \div 24364645 = \frac{3694000}{24360000} = .152$$

$$2. \quad 1586994 \div 18462988 = \frac{1587000}{18460000} = .086$$

$$3. \quad 5525324 \div 6445854 = \frac{5525000}{6446000} = \text{---}$$

$$4. \quad 194.67845 \div 1287.352 = \frac{194.7}{1287.} = \text{---}$$

$$5. \quad 8720.3487 \div 842765 = \frac{8720.}{842800} = \text{---}$$

RECIPROCAL

A DIVISION SHORT CUT

Reciprocals simplify division and are especially convenient when several amounts are to be divided by the same divisor. Multiplying an amount by the reciprocal of the divisor produces the same answer as that obtained by division.

The reciprocal of a number is the quotient obtained by dividing 1 by the number. The reciprocal of 4 is .25 ($1 \div 4$). When any number is multiplied by .25 the same result is obtained as when it is divided by 4. A table of reciprocals (see Form C 1023) is generally used, but when reciprocals are required infrequently they may be obtained by division.

Number of Figures to Use

When multiplying by a reciprocal, use one more digit in both the reciprocal and the dividend than the number of digits required in the answer. (The number of digits in each case is exclusive of preceding ciphers.)

When a number of amounts are to be multiplied by the same reciprocal, as in calculating percentages, the number of digits required in the largest amount is determined and all others may then be cut off at the same point. In the problem shown on page 35 amounts are used only to the nearest thousands of dollars.

Pointing Off

Usually a fixed decimal point for the dividend is established at 5 (between the fifth and sixth columns), but when the dividend is large, as in the following example, the dividend decimal point is established at 2 (between the second and third columns). The color division of the keyboard permits holding the dividend in its normal position as in adding.

An answer decimal point is established in the same manner as in division. In this problem it is placed at seven (seven places to the left of the dividend decimal point, for the seven whole numbers in the divisor, less two for the per cent sign used in writing the answers). Multiplication is performed from left to right.

Operation

Hold the dividend \$2,370,000 over the dividend decimal point established at 2. Multiply from left to right by the reciprocal 1-1-2-7. Answer 26.7%.

Example Problem

Find the percentage of the following items to the total sales, carried to tenths of a per cent:

Material	\$2,369,897 (use 2,370).....	26.7%
Labor	3,452,916 (use 3,453).....	_____
Overhead	976,403 (use 976).....	_____
Selling Cost	1,553,369 (use 1,553).....	_____
Profit	<u>523,724 (use 524).....</u>	_____
Sales	\$8,876,309 (reciprocal 1127).....	100 %

Using a Duplex Calculator

The above method permits accumulating the individual percentages on a duplex but the grand total will not always agree with the addition of the written answers because of fractions dropped in writing them. To obtain the correct total of the written answers, they must be recapped.

The recapping of the individual percentages can be eliminated on the duplex by using the following method:

Pointing Off

When the Duplex Calculator is used to accumulate the results of division by the use of reciprocals, the decimal point for the answer is established as *many places to the left of the third column* (which contains the red "5" key) as *there are decimal places required in the answer*. For example, for answers to tenths of a per cent (3 decimal places), the positioning decimal pointer is set at 6. The answer decimal point is set two places to the right of the positioning decimal point. The decimal non-transfer key is latched down.

Operation

When the dividend contains the same number of whole numbers as the divisor, hold the reciprocal to the right of the positioning decimal point. When the dividend is smaller, move one place to the right for each whole number of difference. Multiply from left to right. Depress the red "5" key in column 3 to adjust the answer to the nearest digit.

Note: When the problem does not involve percentages, the "positioning" decimal point is the "answer" point.

Calculation Tables

Below is a partial list of tables that may be obtained from any Burroughs salesman. Each is printed on a separate card.

Reciprocals of numbers from 1 to 1000.

*Reciprocals of numbers from 1 to 10,000 (Book).

Reciprocals of hours in tenths of hours.

Decimal equivalents of common fractions.

Decimal equivalents of fractional parts of a gross.

Decimal equivalents of fractional parts of an hour, fractional parts of a day, and fractional parts of a month.

Months and days expressed in decimal equivalents of a year.

Table of chain discounts—to determine either amount of discount or net amount.

*Constants for computing interest on the basis of 360 days in a year at rates of 1% to 7% in gradations of $\frac{1}{8}\%$ for 1 day to 180 days. Set of 48 tables on 24 cards.

*Constants for computing interest on the basis of 365 days in a year at rates of 2% to 8% in gradations of $\frac{1}{2}\%$ for 1 day to 180 days. Set of 13 tables on 7 cards.

Constants for computing interest on the basis of 360 days in a year at rates of $\frac{1}{8}\%$ to $12\frac{1}{8}\%$ for one day.

Constants for computing interest on the basis of 365 days in a year at rates of $\frac{1}{8}\%$ to $12\frac{1}{8}\%$ for one day.

Payroll tables for calculating overtime.

Payroll tables for calculating withholding tax.

Table for converting Sterling currency.

Table for converting Indian currency.

Decimal equivalents of fractional parts of a bushel.

Decimal equivalents of fractional parts of a gallon.

Decimal equivalents of fractional parts of a gross ton.

Grain tables.

Lumber table.

Table for figuring steel beams. (Decimal part of a foot for each $\frac{1}{16}$ of an inch.)

Turnover table.

Mark-up table.

Unit cost and selling price table.

Temperature correction chart for tank car billing.

*NOTE: A nominal charge is made for the tables designated by the asterisk. Others are gratis.

